DISPLAY DEVICE WITH TOUCH PANEL

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority from Japanese application JP 2009-004874 filed on Jan. 13, 2009, the content of which is hereby incorporated by reference into this application.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a display device with a touch panel.

[0004] 2. Background Art

[0005] As one of detection methods mainly adopted by a conventional display device with a touch panel, there has been known a detection method which detects a change of light and a detection method which detects a change of an electric characteristic. With respect to these detection methods, the detection method which detects a change of light has a drawback that detection accuracy is not stable.

[0006] On the other hand, as the detection method which detects a change of an electric characteristic, there has been known a resistance film method and a capacity method.

[0007] FIG. **20** shows a conventional capacity-type touch panel. A transparent electrode TLINE which covers the whole surface of a detection region is formed on an inner surface of a glass substrate GSUB. When a user touches a desired position of a touch panel from the outside of the glass substrate GSUB with his finger, capacity between the finger and the transparent electrode TLINE is detected so that coordinates on which the finger is placed is recognized.

[0008] FIG. **21** shows a conventional resistance-film-type panel. A transparent electrode TLINE which covers the whole surface of a detection region is formed on a glass substrate GSUB as a film on one side, a transparent electrode TLINE is formed on a resin RESIN having light transmitting property as a film on another side, and this film is adhered to the glass substrate GSUB such that the transparent electrode TLINE on the resin RESIN faces the transparent electrode TLINE on the glass substrate GSUB in an opposed manner. To prevent the short-circuiting between the respective transparent electrodes TLINE, the transparent spacers SPACERS are arranged in plane so as to hold a fixed distance (several to several tens μm).

[0009] Before the resistance-film-type touch panel shown in FIG. **21** is proposed, as described in JP-A-2002-342014 (patent document 1), there has been known a method in which a transparent electrode is formed into stripe-shaped electrodes and these stripe-shaped transparent electrodes are made intersect with each other thus arranging intersecting portions in a matrix array.

SUMMARY OF THE INVENTION

[0010] The method disclosed in patent document 1 uses the stripe-shaped transparent electrodes and hence, to increase the detection accuracy, it is inevitably necessary to decrease a line width of the stripe-shaped transparent electrode. However, the transparent electrode having a narrow line width exhibits a high resistance value and hence, this method cannot maintain desired detection accuracy. Further, when a thickness of the transparent electrode is increased, it is necessary to take a taper formed by etching into consideration and hence, it is difficult to decrease a gap between the transparent electrodes.

[0011] In view of the above-mentioned circumstances, the previously-mentioned resistance film method has been proposed. In this method, the transparent electrode has high resistance and hence, by making use of a potential difference of voltages applied to the transparent electrodes, input points, that is, contact positions of the upper and lower transparent electrodes are detected one-dimensionally, and such application of voltages and detection of potential difference are performed twice along an X axis and a Y axis so that two-dimensional coordinates are calculated.

[0012] However, the above-mentioned resistance film method has following drawbacks.

[0013] A: The driving principle of this method is based on the application of high resistance property of the transparent electrode made of metal oxide and hence, when the transparent electrode is formed of a low resistance film, a voltage drop becomes small so that the detection becomes impossible.

[0014] B: Since the transparent electrode has high resistance, large-sizing of the touch panel becomes difficult so that a size limit from a practical point of view is considered 17 inches (approximately 200 mm×300 mm).

[0015] C: To detect two or more input points, it is necessary to increase the detection frequency twice or more so that detection accuracy is lowered.

[0016] D: Patterning or forming of transparent electrodes are costly.

[0017] E: The transmissivity of the transparent electrode is limited to approximately 75% to 80% in view of a problem attributed to optical transmissivity of the transparent electrode.

[0018] F: A partial region of a touch panel touched in a concentrated manner in a usual inputting operation. Particularly, when a user performs inputting using a touch pen or with his finger, an external force is applied to input coordinates in a concentrated manner. Due to such an external force, the transparent electrode is bent using the input coordinates as the center and hence, a portion of the transparent electrode in the vicinity of the input coordinates is liable to be damaged.

[0019] G: Since the transparent electrode is made of metal oxide in general, the degradation of the transparent electrode which brings about the increase of resistance of the transparent electrode per se is inevitable thus giving rise to a drawback with respect to reliability in lifetime.

[0020] H: It is necessary to detect a voltage drop by analogue detection and hence, a detection circuit is costly.

[0021] I: Flexible cables which connect the transparent electrodes and the circuits are costly.

[0022] J: Electric current flows in the transparent electrode and hence, the resistance of the transparent electrode is increased.

[0023] K: The transparent electrode is not transparent and hence, coloring occurs whereby a color range of a display panel is displaced.

[0024] In view of such drawbacks, applicants of the present application proposed a touch panel which adopts the new detection structure (Japanese Patent Application 2007-149884). However, according to such a related art, since a plurality of lines are formed on a touch panel and hence, when a user moves a pen on an operation surface in a sliding manner, the user feels the surface unevenness. To overcome this drawback, the inventors of the present invention have